RELATION OF THE WEATHER TO THE YIELD OF WHEAT IN MANITOBA.

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[Extracts.]

(Monthly Bulletin of Agricultural Statistics, Dominion of Canada, April, 1918, pp. 115-125.)

* * * "The plots [at the various experiment stations] are always as near to the meteorological instruments as is found feasible. Dates of sowing, appearance above ground, stooling, stem roots, heading, flowering, milk-stage, maturity, cutting, are carefully noted, as well as the average height of the plants every seven days.

* * * "Some of the preliminary findings were as follows:

"(1) There appeared to be a relation between the length of the period from sowing to heading, or from the appearance of the plants to heading, and the subsequent yield, the longer periods being positively related to the greater yields.

* * * "It therefore appears that the true explanation of the 'critical period' is as follows. If in the earlier stages of the wheat's growth there be cool and rainy weather, the heading will be delayed and the subsequent yield will be heavy, but if the weather be warm and dry, heading will be hastened and the subsequent yield will be light.

* * * "In regard to rainfall there appears that (1) the effect of the rainfall of the 30 days preceding sowing had, in the long run, no effect upon the subsequent yield; (2) in each of the 30 day periods after sowing, and in all combinations of them, the effect of increased rainfall was to increase the yield, except, perhaps, the fourth; (3) the rainfall of the third 30 days after sowing was the most potent in increasing the yield; (4) that the rainfall effect was cumulative, the correlation coefficient for the 120 days being the largest.

"In regard to mean daily range of temperature there appears (1) that in all the 30-day periods succeeding sowing the coefficient was negative, indicating that the yield was increased by a lowered range; (2) that in the case of the first period after sowing the coefficient is negligible; (3) that in the case of the third period the coefficient is largest, five and one-half times the probable error; (4) that any combination of other periods with the third produces a smaller coefficient than that for the third alone.

"In regard to mean daily minimum temperature, we have that (1) the effect of this factor in the first and fourth periods after sowing is zero; (2) in the second and third periods the coefficient is negative, indicating that the yield is increased by a lowered temperature; (3) in the case of the third 30 days after sowing, the coefficient is greatest; (4) combinations of other periods with the third produce a smaller coefficient.

* * * "From the results so far attained it is not educible that there is a critical period of short duration. The coefficients for the third 30 days after sowing are the largest, but this division into 30-day periods was arbitrarily chosen, and there is nothing to show that a larger or smaller period, if chosen, might not have revealed still larger coefficients. From the two sets of data, together, without more detailed treatment, we may assert, with fair justification, that the first 90 days after sowing are very important with regard to moisture and coolness, but that ordinarily there is sufficient moisture in the soil in the first 60 days for the young plants, and low enough ranges of temperature to prevent evaporation to a harmful extent. During the latter part of the 90-day period, however, there will ordinarily obtain midsummer weather with increased probability of heat and drought, and in this regard the last part of the 90 days after sowing may be said to be a "critical period." If in this "critical" time the weather be warm, dry, with great temperature range, the wheat plants will head early and the harvest will be light, but if the cool and moist conditions continue, heading will be postponed and the yield increased. Now, the average date of sowing of wheat in Manitoba since 1890 is approximately April 25, which will fix the average time of the "critical period" as the last week of June and the first three weeks of July. Hence the variability of early July weather may be regarded as the "critical factor" in wheat production in Manitoba.

* * * "The three variables used were the rainfall, mean daily minimum temperature, and mean daily range of temperature, all for the third 30 days after sowing, and it was found that these are to some extent intercorrelated. The minimum is slightly and the rainfall to a much greater degree correlated with the range, both negatively, while there is no relation between the minimum and the rain. Since the rainfall is related positively and the other factors negatively to the yield of wheat, the quotient $\frac{\text{Rain}}{\text{Range} \times \text{minimum}}$ should be related positively. The plotting of these quotients against the yields led to the following equation:

If Y be the yield in bushels per acre,
m the mean minimum temperature,
p the total precipitation for 30 days,
r the mean daily range,
m^1 be $(m-40)$,
then—

$$Y = .434\left(m - \frac{r}{2}\right)\log\frac{1000p}{rm^1}$$

If the mean daily temperature be denoted by t, then the quantity $\left(m - \frac{r}{2}\right)$ may be written $(t-r)$.[1]

PREDICTING MINIMUM TEMPERATURES.[2]

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[Author's abstract.]

A mathematical discussion of the relation between the relative humidity in the late afternoon and the variation of the minimum temperature during the coming night from the afternoon dewpoint temperature, when radiation conditions prevail.

The study shows that there is a well-defined relation which can be expressed by the curve for a parabola. This curve can be constructed by the "star point" method of curve fitting instead of by the more tedious well-known least square method.

[1] It is probable that closer approximation might be obtained by least-square treatment of $(m-40)$, the constant 40 being slightly changed.

[2] Presented before the Philosophical Society of Washington Dec. 20, 1919, and the American Meteorological Society, St. Louis, Dec. 30, 1919. To be published in full in MONTHLY WEATHER REVIEW SUPPLEMENT 16, 1920.